

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-319680

(43)Date of publication of application : 03.12.1996

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(51)Int.Cl. E04B 1/86  
G10K 11/16

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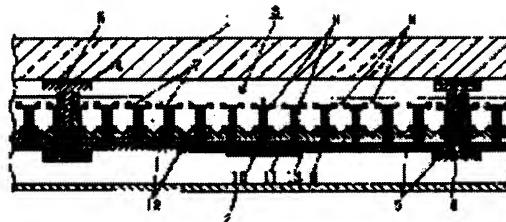
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## (54) SOUND INSULATING DEVICE

### (57)Abstract:

**PURPOSE:** To make it possible to relax the sound generated by walking on a floor by connecting a plurality of vessels having an opening or a plurality of units which provide an opening chamber between the rear surface of a story floor and a ceiling on a board.

**CONSTITUTION:** A board 6 and a plurality of vessels 7, which are laid out in the form of a flat plate on the board 6, are installed on a sound insulating chamber 3 and opposed to each other on a floor board 1 which uses the opening 8 of each opening vessel 7 as a sound source. Then, each opening vessel 7 is arranged to act as a vibration insulating material 5. For example, it is laid out on the board 6 by way of felt or butyl rubber. In addition, a foam or butyl rubber or the like which acts similarly as a vibration insulating material is laid out between each vessel 7. In this case, these boards 6 and vessels 7 are modulated on an unit basis. Each unit is installed between beams 4. Furthermore, each unit is connected with a connecting material 10 and a wood screw 11. A sound absorbing material 12 is housed in each opening vessel 7 while a rear air layer 13 is installed between the bottom of the vessel and the sound absorbing material 12, which makes it possible to attenuate the sound which spreads in each vessel effectively.



**LEGAL STATUS**

[Date of request for examination] 14.01.1998

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3072023

[Date of registration] 26.05.2000

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

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## [Claim(s)]

[Claim 1] Noise insulating equipment characterized by having had the opening container of a large number arranged to the plane on a unit substrate and this unit substrate, having arranged acoustic material in each opening container, and constituting so that the acoustic wave from a sound source may be attenuated with each opening container.

[Claim 2] Noise insulating equipment characterized by constituting so that the restricted mold vibration isolation material which contains a viscoelasticity member between said unit substrates and opening containers or between the opening containers which adjoin mutually may be arranged in noise insulating equipment according to claim 1.

[Claim 3] Noise insulating equipment characterized by having had the unit substrate, the diaphragm which is arranged on this substrate and forms many noise insulation rooms, and the upside plate arranged on a diaphragm, and having arranged acoustic material to each noise insulation interior of a room, respectively.

[Claim 4] Noise insulating equipment characterized by forming opening in said upside plate for every noise insulation room, respectively in noise insulating equipment according to claim 3.

[Claim 5] Noise insulating equipment characterized by having formed the back air space between said acoustic material and unit substrates, and reinforcing further the absorption-of-sound effectiveness by acoustic material in noise insulating equipment given in any 1 term from claim 1 to claim 4.

[Claim 6] Noise insulating equipment characterized by constituting so that an acoustic wave may decline by air resistance in the process spread in the noise insulation room where a breakthrough is formed in said diaphragm and the acoustic wave which carried out incidence adjoins each noise insulation room through a breakthrough in noise insulating equipment given in any 1 term from claim 3 to claim 5.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]**

**[0001]**

[Industrial Application] Without installing in the so-called underpart-of-the-roof space between the floor of an upper story, and head lining of a lower story, and affecting dwelling space about the noise insulating equipment of a building, it runs about and this invention relates to especially suitable equipment to ease the weight floor impact sound and light-weight impact sound which are a sound above the floor level generated by walk etc. However, since this invention is what installs the equipment which compounded each means of the noise insulation and absorption of sound make hard to spread the sound and oscillation which are generated as a result of the oscillation of the floor plate of an upper story, vibration control, and damping in the space of a floor plate and head lining, utilization in an effective and wide range industrial field is fundamentally possible for it not only to a floor impact sound but all sound sources.

**[0002]**

[Description of the Prior Art] Conventionally, about relaxation of a floor impact sound, against the weight sound, the rigidity of a floor plate is raised, or the cure of increasing the weight of a floor plate is taken, and, on the other hand, reducing the exciting force to a floor plate as a false floor which makes flooring material soft etc. was performed to the lightweight sound. Consequently, since the rigidity of a floor plate and weight increase, it will be necessary to raise the reinforcement of a column or a beam, and in the apartment of concrete \*\*, floor plate thickness and use of iron rods will increase, and an installed cost also increases in connection with this.

[0003] On the other hand, although void slab, waffle slab, etc. which are lightweight-ized are used giving space and maintaining rigidity in slab, since floor plate thickness becomes thick and the height of the whole building becomes high, when the weight of a floor, a column, and a beam increases and the supply number of houses per the first floor decreases, a construction increase in cost is caused.

[0004] Moreover, in single houses and low level flats, such as a wooden traditional method of construction and offsite component fabrication \*\*, since a building was flexible structure, the floor impact sound was hard to be improved, and there was a problem which head lining and a wall especially also resonate with weight impulsive sound besides a floor plate, and a loud radiation sound generates.

[0005] The sound engine performance is LL-45 by considering as a false floor or on the other hand, making flooring, such as a carpet finishing floor, soft to lightweight impulsive sound, etc. The flooring below a grade is developed and marketed. However, since cleaning up serves as a hotbed of noxious insects, such as ticks, being easy to become inadequate as for a carpet, the woody noise control floor is used abundantly from a sanitary viewpoint.

[0006] however, since it steps on and the feeling is generally recognized to be a hard thing, woody finish material is soft -- by stepping on, although the sound engine performance of the woody floor of a feeling is good, it is kept at arm's length by the resident. That is, it was difficult to estimate the sound engine performance of a woody floor, and for a feeling to conflict, and to reconcile these.

[0007] Moreover, since floors always are not exchanged and it is semipermanently used by one side for

a long period of time, the sound engine performance must not change with long-term activities. However, since the ingredient used in order to reduce a floor impact sound produces a compression set by long time loading in the case of fiber, foam, etc., it is known that the problem to which the relaxation effect to a floor impact falls to, and the reduction effectiveness of a floor impact sound will arise. [0008] as mentioned above, about a weight sound, as for the research for reducing a floor impact sound, increment in the thickness of the floor plate itself, rigid increment, and lightweight-ization are performed -- \*\*\*\* -- the actual condition is that do not pass and only examination in respect of the construction material of flooring is performed about the lightweight sound.

[0009]

[Problem(s) to be Solved by the Invention] The technical problems which are going to solve this invention are not carrying out degradation, even if it makes available attenuating \*\* floor impact sound in a large frequency band, and for a long period of time [ \*\* ], and proposing the noise insulating equipment with which are satisfied of the Sanjo affair of narrowing-\*\* dwelling space \*\*.

[0010] this invention person etc. checked by many experiments that it was possible for it to be simultaneously satisfied with the space between head linings and the floor plates which are the source of release of a radiation sound of the above-mentioned monograph affair based on the trouble mentioned above if the equipment which attenuates a radiation sound is installed, and completed this invention.

[0011]

It is operation] to [The means for solving a technical problem list. The noise insulating equipment by this invention is characterized by having had the opening container of a large number arranged to the plane on a unit substrate and this unit substrate, having arranged acoustic material in each opening container, and constituting so that the acoustic wave from a sound source may be attenuated with each opening container.

[0012] This invention attains noise insulating equipment fundamentally using the principle of the resonator of helmholtz. For this reason, many opening containers are arranged on a unit substrate at a plane. Since the building envelope of an opening container acts as the cavity section, the air in a container can repeat compression and expansion by the acoustic wave which carried out incidence through opening, and it can attenuate the energy of an acoustic wave. In order to demonstrate a remarkable damping effect to the sound source of a specific frequency by choosing the volume of an opening container appropriately especially, the volume of an opening container is set up so that the frequency of a floor impact sound may be suited. Thereby, the outstanding effect of intercepting noise is demonstrated.

[0013] Furthermore by this invention, acoustic material is arranged in an opening container. As an acoustic material, textile materials, such as rock wool, glass wool, felt, and a nonwoven fabric, a cork, rubber, foam, etc. can be used. Thus, by arranging acoustic material in an opening container, in addition to the damping effect of an opening container, the damping effect by acoustic material is attained, and the further excellent effect of intercepting noise can be attained.

[0014] The suitable example of the noise insulating equipment by this invention is characterized by constituting so that the restricted mold vibration isolation material which contains a viscoelasticity member between a unit substrate and an opening container or in either [ at least ] between the opening containers which adjoin mutually may be arranged. By arranging vibration isolation material between an opening container and a unit substrate or between adjoining opening containers, if an acoustic wave carries out incidence, each opening container can perform a restricted oscillation and can give the damping effectiveness also to the oscillation of the opening container itself. Consequently, the frequency band of the acoustic wave which insulates is further expandable.

[0015] Another noise insulating equipment by this invention is equipped with a unit substrate, the diaphragm which is arranged on this substrate and forms many noise insulation rooms, and the upside plate arranged on a diaphragm, and arranges acoustic material to each noise insulation interior of a room, respectively. The noise insulation room of a large number formed with the unit substrate, the diaphragm, and the upside plate can attenuate the energy of an acoustic wave, when it acts as the cavity resonance section to the acoustic wave which carried out incidence as mentioned above, consequently an

internal air space compresses and expands. In this case, by preparing opening for every noise insulation room, respectively, the effectiveness as a resonator of helmholtz becomes much more effective, and an effect of intercepting noise carries out size.

[0016] if acoustic material is arranged in the above-mentioned suitable example so that a back air space may be formed in the noise insulation interior of a room, while the absorption-of-sound effectiveness of acoustic material will act much more effectively by forming in each noise insulation interior of a room two noise insulation space which acoustic material separated, it comes to receive attenuation twice, and the acoustic wave which carried out incidence also boils the damping effect over an acoustic wave markedly, and reinforces it.

[0017] Furthermore, the suitable example of this invention forms a breakthrough in said diaphragm, and it constitutes it so that an acoustic wave may decline by air resistance in the process spread in the noise insulation room where the acoustic wave which carried out incidence adjoins each noise insulation room through a breakthrough. Thus, by preparing a breakthrough in a diaphragm, the acoustic wave which carried out incidence to each noise insulation room is spread to the noise insulation room which adjoins through a breakthrough further, and the damping effect over an acoustic wave increases further according to the mutual-intervention operation between acoustic waves.

[0018] Since the unit which the degradation by access does not have over a long period of time, either, since it is not influenced of a load and others, and compounded each function of noise insulation, absorption of sound, vibration control, and damping is combined according to this invention, without narrowing dwelling space, the oscillation and radiation sound which were generated with the floor plate can be eased, and since it is effective in a still larger frequency band, effectiveness can be demonstrated to both weight impulsive sound and lightweight impulsive sound.

[0019] The box-like unit substrate and plane unit substrate used as the unit substrate of the noise insulating equipment of this invention Woody material, such as a plywood, a fibre insulation board, the Century board, and timber, Paper material, such as corrugated paper, a vinyl chloride, ABS, polyethylene, polypropylene, Rubber, such as synthetic resin, such as an acrylic, natural rubber, and EPT, BR, CR, IR, IIR, Epoxy, unsaturated polyester, a phenol, urethane, liquid rubber, Reaction hardening mold liquefied resin, such as silicon, plaster board, a cemented excelsior board, a flexible board, independent in metal plates, such as compression molding tabular objects, such as minerals plates, such as a hollow cement extrusion molding plate, a glass fiber, rock wool, a nonwoven fabric, and felt, iron, stainless steel, aluminum, and lead, -- or it uses together and is usable.

[0020] moreover, the plane substrate with which a box-like unit substrate consists of the aforementioned ingredient -- \*\*\*\*\* -- \*\*\*\* -- what was produced by one molding of plastics etc. may be used.

[0021] The point which should be taken into consideration about a box-like unit substrate and especially a plane unit substrate In order to prevent that what has high surface density is desirable as for a noise insulation engine-performance top, and the radiation sound from a substrate, a rib and reinforcing materials are prepared and the rigidity as a unit is raised, Considering as constraint or non-restraining mold damping with combination with a sound deadener, not uniting the fixed position of a unit with a floor plate or head lining, and by fixing through vibration isolation material, in carrying out connection immobilization with a floor plate, a beam, and head lining further It is much more effective to consider as the structure which a radiation sound does not generate of being hard to vibrate.

[0022] In the connection sections, such as between units and a unit edge, it is required to consider to use vibration isolation material, a joint plate, etc. between a tabular object and a box-like object and a joint as phase rule junction or \*\*\*\* junction so that a clearance may not be generated, and to prevent the sound leakage from a clearance.

[0023] Although an opening container has constraint neither in construction material nor especially thickness like a box-like unit substrate and a plane unit substrate, in the case of the metal which is thin rigid high construction material, or high rigidity plastics, there is a possibility of the opening container itself vibrating and generating a radiation sound. However, vibration isolation material, such as fiber, such as rock wool, glass wool, felt, and a nonwoven fabric, a cork, rubber, and foam, acoustic material, a damper, etc. can be made into independent or the structure which a radiation sound does not generate by

using together and preparing in a part of inner circumference of an opening container, periphery, or the upper part [ at least ], and such structure becomes effective especially to subsonic vibration. Moreover, the effectiveness which was excellent also when the container wall of an opening container was further fixed through a viscoelastic body through a fiber, foam, and a viscoelastic body between the opening container bases which touch a box-like unit substrate and a plane unit substrate in this case is demonstrated. That is, between a container pars basilaris ossis occipitalis, a box-like unit substrate, or a container pars basilaris ossis occipitalis and a plane unit substrate, when damping the subsonic vibration which damping by the horizontal restricted effectiveness is performed, serves as restricted mold damping structure of the biaxial direction by performing damping according to the vertical restricted effectiveness in between the container walls of a container on the other hand, and is very hard to decrease, it is very effective.

[0024] Moreover, the absorption-of-sound effectiveness by the side of a RF can be further raised by arranging the acoustic material of a fiber system and a foam system between opening containers, or preparing the foam of a fiber system or an open cell mold in the top face of an opening container.

[0025] At the interior of an opening container, and a noise insulation room, while putting in layer-like acoustic material in these space, the effectiveness improves further by making the internal configuration into a concavo-convex field by raising the absorption-of-sound effectiveness of the sound of the number field of medium frequency from low frequency, making between acoustic material and container bottoms into space further, and preparing a back air space.

[0026] moreover, the thing for which the field which inclined to the container bottom is formed in an opening container bottom using the matter with the large specific gravity of the sand hardened with gypsum fibrosum, cement, and a binder -- an echo of a sound -- be generated -- the course of an acoustic wave -- though it is fixed space, since merit is attenuated by lengthen, the reduction effectiveness of a low frequency sound is improvable.

[0027] When the noise insulation room which formed the diaphragm between the plane unit substrate and the upside plate is installed, the rigidity of a unit can be raised with a diaphragm and it becomes the structure where the unit itself cannot vibrate easily.

[0028] Moreover, if opening is prepared in an upside plate in this unit and a cone or a pyramid object is arranged to that opening, when the absorption-of-sound effectiveness will become high, the reflection effect of a sound can also be used collectively. In this case, in a perimeter wave number field, the reduction effectiveness of a sound is acquired by filling up with the sand containing gypsum fibrosum, cement, or a binder etc. the space formed between an anapleurum-like object, and a cone and a pyramid object. Furthermore, the reduction effectiveness of a low frequency sound can be further heightened by pasting up through a viscoelastic body between a tabular object, a cone and a pyramid object, gypsum fibrosum, cement, etc.

[0029] What also really fabricated the independent thing so that it might mention later is sufficient at a time as one opening container. Although there is especially no constraint about a configuration, in order to reduce subsonic vibration, the one of height with the sufficient and higher one where the area of opening is also larger is good, and its one where the thickness is also thicker is good. However, since the above-mentioned approach is used together in order to send effectiveness in the large range ranging from the low frequency to a RF, and some differences arise also according to the structure of a building, it is much more effective to consider as the unit of the optimal configuration corresponding to this and structure.

[0030] The ingredient which it is easy to cut wood quality, plastics, gypsum fibrosum, etc., and is hard to be injured by the cutting piece on the other hand since the sectility in a site is thought as important about construction workability is desirable. Moreover, by using noncombustible plaster board, a cement plate, etc. in preparation for the time of an emergency fire, the duty of duplex head lining is also achieved and the effectiveness of delaying a spreading fire rate is also produced.

[0031]

[Example] Hereafter, this invention is concretely explained in full detail according to an example.

[0032] Drawing 1 is the sectional view by this invention showing the example which installed the noise

insulating equipment 3 which installed the opening container on the substrate. It prevents that the impulsive sound generated with the floor plate 1 spreads to a crown plate 2 with noise insulating equipment 3. Noise insulating equipment 3 is connected with a floor plate 1 through a beam 4. The vibration isolation material 5 is made for a list to intervene between a beam 4 and a floor plate 1 between a beam 4 and noise insulating equipment 3.

[0033] Noise insulating equipment 3 has a substrate 6 and two or more opening containers 7 arranged on this substrate at the plane, and the opening 8 of each opening container counters the floor plate 1 used as a sound source. For example, each opening container acts as vibration isolation material 5, it is arranged on a substrate through the felt or isobutylene isoprene rubber. Moreover, the foam which acts as vibration isolation material 9 similarly between each container, isobutylene isoprene rubber, etc. are made to intervene. Unitization of these substrates and the opening container is carried out, and they install each unit in span direction. Each unit is joined to the accouplement 10 with the wood screw 11. Furthermore, the sound spread in each container can be effectively attenuated by containing acoustic material 12 in each opening container, and forming the back air space 13 between a container pars basilaris ossis occipitalis and acoustic material.

[0034] Drawing 2 shows an example of the unit of the substrate shown in drawing 1, and the noise insulating equipment which consists of opening containers. This unit 14 carried out phase rule junction of the two plates 15 and 16 as a substrate, and has prevented the sound leakage of a joint. On this substrate, two or more opening containers 18 which have opening 17 are installed.

[0035] Drawing 3 shows other examples of the unit of the noise insulating equipment shown in drawing 1. This unit 19 is considered as the configuration which installed two or more opening containers 22 which have opening 21 in the box-like substrate 20. Thus, unitization of two or more containers can be easily carried out by using a box-like substrate.

[0036] Drawing 4 shows the sectional view about the modification 23 of the 1st example of the noise insulating equipment by this invention. Two plates 24 and 25 of each other were shifted, superposition and a phase rule joint were prepared, and the sound leakage from the clearance between joints is prevented. On a plate 25, the sheet of isobutylene isoprene rubber is laid as vibration isolation material 26, opening is turned upward and two or more containers 28 which have opening 27 on it are installed. Moreover, the vibration isolation material 29 is formed also in the clearance between each container.

[0037] Drawing 5 shows the sectional view about the modification 30 of the 1st example of the noise insulating equipment by this invention. The box-like substrate 31 piled up and produced plaster board and a plywood, laid the felt 32 with a thickness of 10mm as vibration isolation material at the pars basilaris ossis occipitalis, and arranges opening for the opening container 33 upward on it. Between containers, it was filled up with the liquefied foaming hardening ingredient 34, and foaming hardening was carried out so that it might become height of 10cm from a container bottom after foaming hardening. In order that this foaming hardening ingredient may sink into the felt in part in the phase of a liquefied object until it hardens and may paste up between containers and between a container pars basilaris ossis occipitalis and the felt, it demonstrates the restricted effectiveness. Moreover, the container 33 interior is filled up with the concave surface-like acoustic material 35 which consists of felt so that a cross section may form a concave side, and the absorption-of-sound effectiveness is made to increase to it.

[0038] Drawing 6 </A> shows the sectional view about the modification 36 of the 1st example of the noise insulating equipment by this invention. Although the felt 38 was laid in the box-like substrate 37, the opening container 39 is arranged on it like drawing 5 and it is filled up with the charge 40 of foam between containers, make opening container 39 pars basilaris ossis occipitalis incline, slush mortar 41 at it, and it is made to harden, and it is installing so that the concave surface-like acoustic material 42 may be formed on it and the back air space 43 may be formed between mortar 41.

[0039] Drawing 7 is the sectional view showing having fixed a floor plate and head lining to the independent grid-like receptacle tree between the floor plate of an upper story, and head lining of a lower story as the 2nd example of the noise insulating equipment by this invention. Noise insulating equipment 44 is installed on the grid-like receptacle tree 47 currently supported by the supporter

material which is not illustrated between a floor plate 45 and head lining 46, and 48. With this equipment, two or more space 52 with the up plate 49, the lower plate 50, and a diaphragm 51 is formed. And it prevents that the impulsive sound generated with the floor plate spreads to the crown plate of a lower story by forming such space.

[0040] Drawing 8 shows the sectional view about the modification 53 of the 2nd example of the noise insulating equipment by this invention. Diaphragms 56 and 57 are formed in the up-and-down plaster board 54 and the perimeter between 55. Junction between diaphragms is considered as \*\*\*\* junction, and heights are established in the right-hand side diaphragm 56, and it establishes a crevice in the left-hand side diaphragm 57, respectively. Furthermore between plaster board, a diaphragm 58 is formed in the shape of a grid, and a partition is formed by carrying out the fragmentation rate of the interior. In each partition, the acoustic material 59 which consists of rock wool, and the safety catch material 60 supporting this are formed. The space divided with acoustic material 59, the safety catch material 60, and the lower plaster board 55 has the effectiveness of raising the absorption-of-sound effectiveness more, as a back air space 61. Moreover, the effectiveness as a back air space that the space 62 which could come, simultaneously was divided with acoustic material 59 and the upper plaster board 54 is also the same is brought about.

[0041] Drawing 9 shows the sectional view about the modification 63 of the 2nd example of the noise insulating equipment by this invention. Like the example shown in drawing 6, the partition was prepared with diaphragms 66, 67, and 68 between the up-and-down plaster board 64 and 65, and acoustic material 69, the safety catch material 70 supporting this, and the back air space 71 are formed in each partition. An air hole 72 is formed in a diaphragm 68, and it has structure which carries out aeration into each partition.

[0042] Drawing 10 shows the sectional view about the modification 74 of the 2nd example of the noise insulating equipment by this invention. Like the example shown in drawing 8 and drawing 9, the partition was prepared with diaphragms 77, 78, and 79 between the up-and-down plaster board 75 and 76, and acoustic material 80, the safety catch material 81 supporting this, and the back air space 82 are formed in each partition. moreover, the upper plaster board 75 -- opening 83 -- preparing -- this opening lifter -- a rectangular-head drill-like funnel -- the \*\* member 84 is pasted up with plaster board 75 with mortar 86 through the viscoelastic body 85 which has an adhesive property with mortar. this funnel -- by the \*\* member 84, the amount of propagation of the acoustic wave by the side of head lining is decreased using an echo of the acoustic wave produced from the relation between the incident angle of an acoustic wave, and angle of reflection.

[0043] Drawing 11 shows the sectional view about the modification 88 of the 2nd example of the noise insulating equipment by this invention. The viscoelastic body 90 was stuck on the substrate 89, the opening container 91 really fabricated succeeding a it top was installed, acoustic material 92 was further formed on the container, and space 93 is formed in the container.

[0044] Drawing 12 shows the top view of the second floor floor of the laboratory which measured the floor impact sound to the test piece concerning each example of this invention. It is magnitude to the center section of the floor plate 94. The opening 95 of 1.8mx 1.8m was formed, and three ALC floor plates 96 are attached into it. Moreover, five RBIs 97 are formed on the diagonal line.

[0045] Drawing 13 shows the top view of the first floor of the laboratory which measured the floor impact sound to each example of this invention. the intersection of the diagonal line on a floor plate 98 - - and -- It measured by carrying out sound reception in a total of five point of measurement 99 of one fourth of points. On the occasion of measurement, both install the test piece concerning an example independently, and perform it to the space between the second floor floor and the first floor floor.

[0046] Drawing 14 shows the schematic diagram of a measuring device. Precision sound level meter 101 Connected microphone 100 It is a frequency analyzer 102 about the received sound. It analyzes and is a recorder. A result is recorded by 103.

[0047] Hereafter, each example of this invention and the measurement result using this are explained in full detail.

[0048] Production Unit A of Test Piece : 1. To Tabular Lifter Which Could Shift Respectively Two

Plaster Board 24 and 25 with a 9Mm[ in Thickness ] X Width-of-Face [ of 45Cm ] X Die Length of 90Cm for Sectional View 10Cm in Width of Face and the Die-Length Direction as Shown in Drawing 4 , and Prepared and Piled Up Phase Rule Joint In width-of-face [ of 15cm ] x die-length [ of 15cm ] x height of 20cm, between the bottom of a tabular object and a container and the container wall of a container was fixed for the container 28 made from polyethylene which has the circular opening 27 with a diameter of 9cm, respectively with the isobutylene-isoprene-rubber viscoelastic bodies 26 and 29 with a thickness of 1mm, and Unit A was produced.

[0049] Unit B: The opening container 33 which cut 5cm of upper parts of the opening container which used the sectional view for Unit A as shown in drawing 5 , and the container of isomorphism, and set opening to 15cmx15cm is produced, and it is filled up with the felt 35 so that a concave side may be formed in the interior. After covering the pars basilaris ossis occipitalis of the lamination \*\*\*\*\* substrate 31 with the felt 32 with a thickness of 10mm for a plywood with a thickness of 12mm and plaster board with a thickness of 9mm and installing this container, the unit B which was filled up with the liquefied foaming effectiveness ingredient 34, and carried out foaming hardening to 10cm height of a container between containers was produced.

[0050] Unit C : The opening container and the isomorphism-like opening container 39 which used the sectional view for Unit B as shown in drawing 6 are produced. The field which slushes cement mortar 41 into the pars basilaris ossis occipitalis of the container, and serves as a base and an include angle of about 30 degrees is established. The unit C which formed the felt 38 in the pars basilaris ossis occipitalis of the box-like substrate 37, and formed foam 40 for the container which furthermore set the height of the back air space 43 to 30mm, and was filled up with the concave surface-like acoustic material 42 between containers like Unit B was produced.

[0051] Unit D : As shown in drawing 8 , the perimeter between two plaster board 54 with a 9mm[ in thickness ] x width-of-face [ of 45cm ] x die length of 90cm and 55 is divided with the diaphragms 56 and 57 with a width-of-face [ of 5cm ] x height of 10cm for a sectional view. The unit D which formed the dashboard 58 with a width-of-face [ of 1cm ] x height of 10cm for the interior in the shape of a grid in all directions in 15cm pitch, and formed the rock wool 59 with a thickness of 2cm and the back air space 61 with a thickness of 5cm in the interior of a grid was produced.

[0052] Unit E: As shown in drawing 9 , the unit E which formed the air hole 72 with a diameter of 10mm in the diaphragm 68 was produced [ as opposed to / for a sectional view / the \*\*\*\*\* partition section of Unit D and the unit of the same configuration ].

[0053] Unit F: As shown in drawing 10, form opening 83 in anapleurum 75 and mind [ in / for a sectional view / Unit D and the unit of the same configuration ] cement mortar 86 for the rectangular-head drill-like funnel 84, and it is a mounting beam. In addition, the part which touches a plate and the cement mortar of a funnel formed beforehand the playback isobutylene-isoprene-rubber system viscoelastic body 85 which has an adhesive property with raw mortar. This was made into Unit F.

[0054] Unit G: The opening container 91 made from vinyl chloride which really processed it into the plywood 89 with a 12mm[ in thickness ] x width-of-face [ of 45cm ] x die length of 90cm continuously, and made the sectional view as shown in drawing 11 was stuck using the viscoelastic body 90, and the unit G which formed rock wool 92 on the opening container 91 was produced.

[0055] 2. About the installation unit A - Unit G of a test piece, it is [ a floor plate and head lining, and ] a mounting beam without a clearance independently, respectively.

[0056] 3. As shown in measurement drawing 12 of a test-method floor impact sound, it is magnitude to the floor plate 94 of the second floor. The opening 95 of 1.8mx 1.8m is formed, and it is thickness. 100mm, magnitude Three ALC floor plates 96 of 0.6mx 1.8m were put in order, and from on the, cement mortar was \*\*\*\*\* (ed) 10mm and offered as a sample after desiccation. About the sound which formed five RBIs 97 on the floor plate, gave an impact to each RBI, and was generated, measurement is the height on the floor plate 98 of a lower story, as shown in drawing 13. It measured at the sound reception point 99 prepared in the place with a height of 1.2m five places, and the average of the measured value in each sound reception point showed the result. The trial item was made into two kinds, weight impulsive sound and lightweight impulsive sound.

[0057] The measurement result of a floor impact sound is shown in a table. In addition, the example of a comparison in this table shows the case where noise insulating equipment is not installed between a floor plate and head lining.

[0058]

[A table 1]

		ユニット							比較例
		A	B	C	D	E	F	G	
重量衝撃音	63Hz	89dB	85dB	82dB	89dB	88dB	82dB	90dB	94dB
	125	80	74	72	78	77	71	82	90
	250	71	67	64	70	68	64	75	82
	500	66	59	55	62	60	57	69	78
	1000	59	49	46	53	52	48	60	68
	2000	44	40	38	41	40	39	53	61
	4000	34	32	31	36	35	33	42	57
	L <sub>H</sub> 等級	L <sub>H</sub> 65	L <sub>H</sub> 60	L <sub>H</sub> 60	L <sub>H</sub> 65	L <sub>H</sub> 65	L <sub>H</sub> 60	L <sub>H</sub> 70	L <sub>H</sub> 80
軽量衝撃音	63Hz	70dB	70dB	68dB	72dB	70dB	67dB	73dB	76dB
	125	71	72	69	75	73	68	76	80
	250	74	70	67	72	68	67	77	85
	500	64	64	62	63	62	61	72	79
	1000	49	50	48	49	50	49	54	64
	2000	33	34	32	31	31	33	36	51
	4000	20	20	18	18	18	19	23	36
	L <sub>L</sub> 等級	L <sub>L</sub> 70	L <sub>L</sub> 65	L <sub>L</sub> 60	L <sub>L</sub> 65	L <sub>L</sub> 60	L <sub>L</sub> 60	L <sub>L</sub> 70	L <sub>L</sub> 80

[0059] The effectiveness of this invention is explained based on a test result.

[0060] Upwards Unit A piled up two plaster board, arranges an opening container, and shows the case where connection immobilization between the bottoms of a tabular object and a container and of between the container walls of a container is carried out with the viscoelastic substance at that time. Compared with the non-processed example of a comparison, a weight sound has three ranks, a lightweight sound has the improvement of two ranks, and the improvement was found in the perimeter wave number region.

[0061] Unit B is the example which set the opening container into box-like [ which piled up a plywood and plaster board ], fixed between a box-like object and container bottoms with the felt, fixed between containers by foam, respectively, and prepared acoustic material in the shape of a concave surface in the container. It was effective to the large frequency.

[0062] Unit C is the example which prepared the field which serves as an include angle of about 30 degrees with cement mortar, and the back air space in the bottom inside the container of a test piece 5. The improvement effect of a low frequency sound arose also especially in this case, and the improvement of four ranks was able to do the weight sound and the lightweight sound.

[0063] Unit D is the example which prepared space with the diaphragm between two plaster board, and prepared acoustic material in the space. The improvement of three ranks was found for the weight sound and the lightweight sound.

[0064] Unit E is the example which established the free passage hole in the diaphragm, and the effectiveness of amelioration is seen in a low frequency sound compared with Unit D.

[0065] Unit F -- anapleurum material -- opening -- preparing -- opening -- the funnel of a pyramid mold -- the \*\* member -- installing -- further -- a plate and a funnel -- it is the example which prepared cement mortar through the viscoelastic body between the \*\* members. The low frequency sound which is especially hard to reduce is improved greatly, and the improvement effect of five ranks was seen also for the engine performance so that more clearly than a test result.

[0066] Unit G is the example which fixed the really cast opening container to the plywood with the viscoelastic body, and prepared acoustic material upwards. Also in this case, a weight sound and two ranks of lightweight sounds are improved, and it was effective in floor impact sound reduction.

[0067]

[Effect of the Invention] As mentioned above, by using effectively the space of the floor plate which was not used conventionally and head lining, the floor impact sound could be eased, the reduction effectiveness in a low frequency field was size, and especially Unit C and Unit F had it in the frequency domain large also in the other examples. [ effective ]

[0068] In addition, since each unit used for the test piece of this invention performs a floor plate and flooring using the conventional product, it can reduce a floor impact sound by using together with these amelioration, excelling in a feeling of a walk and suppressing the increase of weight.

[0069] As mentioned above, utilization in a wide range industrial field is possible for this invention from the ability to demonstrate effectiveness to all sound sources for it to be not only dramatically useful, but, when offering comfortable dwelling space.

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[Translation done.]

JAPANESE [JP,08-319680,A]

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE  
INVENTION TECHNICAL PROBLEM OPERATION EXAMPLE DESCRIPTION OF DRAWINGS  
DRAWINGS

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[Translation done.]

## \* NOTICES \*

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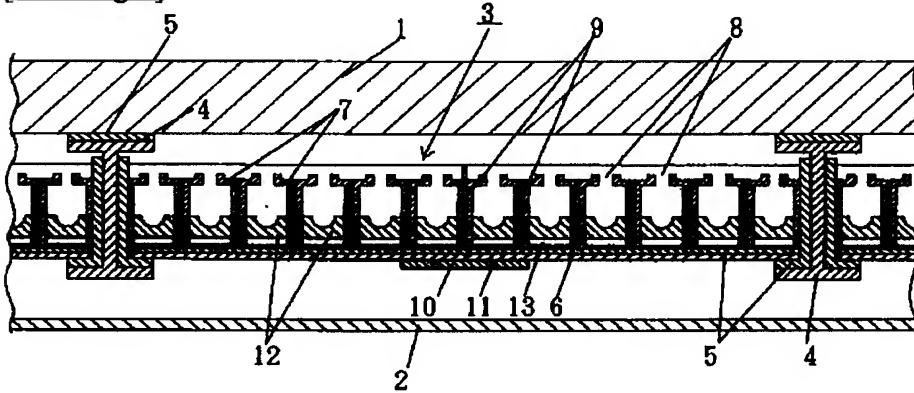
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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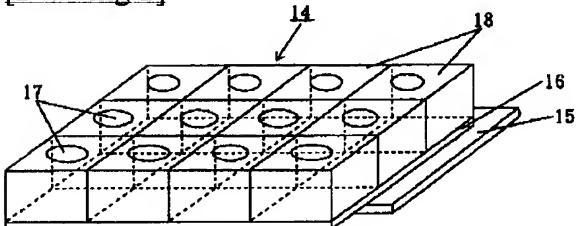
DRAWINGS

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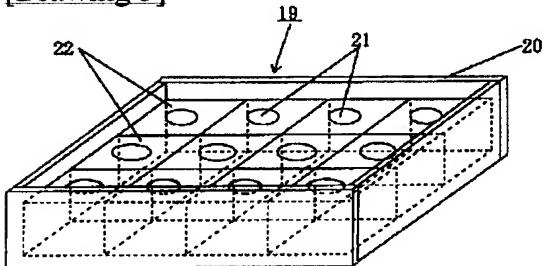
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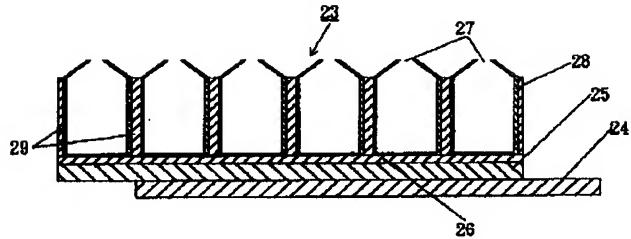
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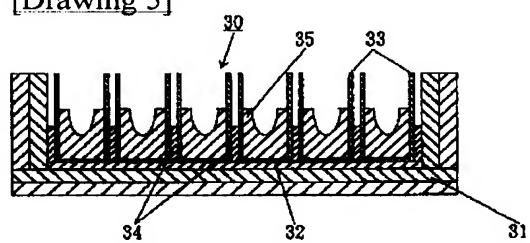
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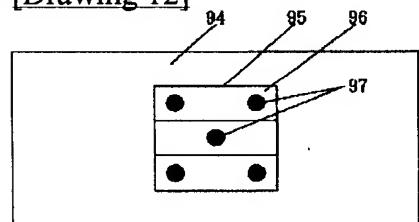
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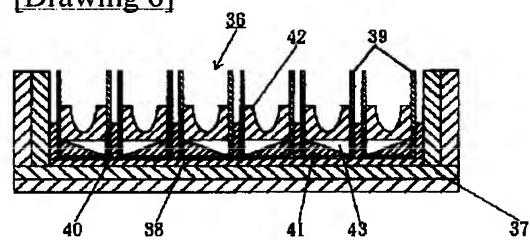
[Drawing 5]



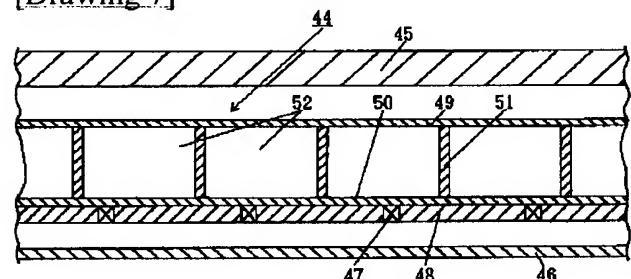
[Drawing 12]



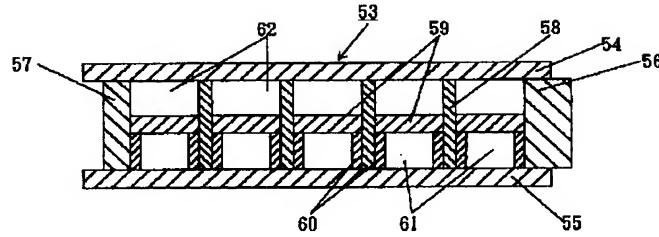
[Drawing 6]



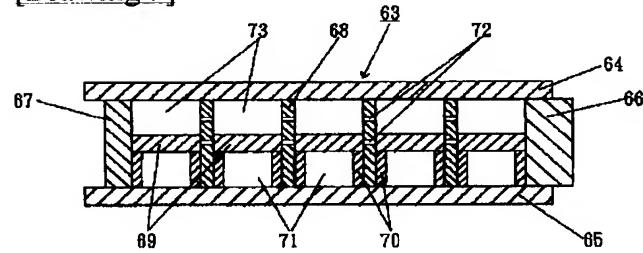
[Drawing 7]



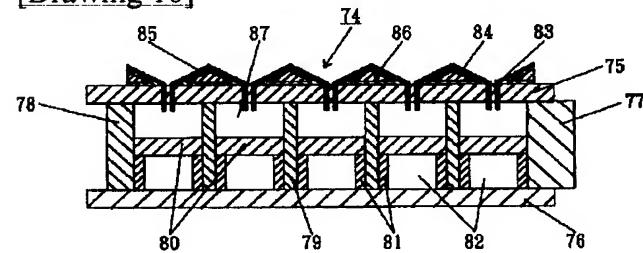
[Drawing 8]



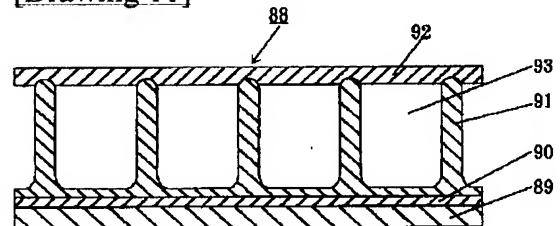
[Drawing 9]



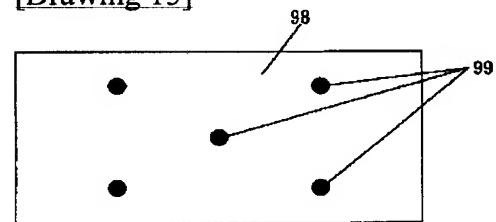
[Drawing 10]



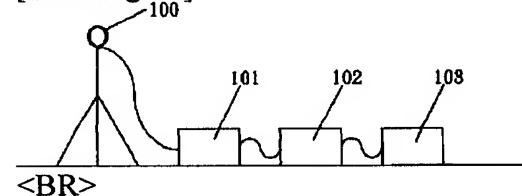
[Drawing 11]



[Drawing 13]



[Drawing 14]



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[Translation done.]

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-319680  
 (43)Date of publication of application : 03.12.1996

(51)Int.Cl. E04B 1/86  
 G10K 11/16

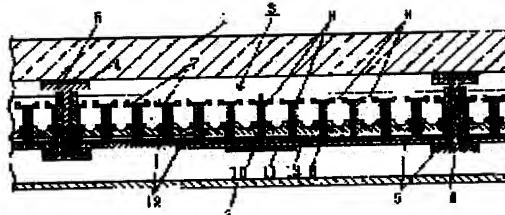
(21)Application number : 07-124659 (71)Applicant : HAYAKAWA RUBBER CO LTD  
 (22)Date of filing : 24.05.1995 (72)Inventor : KAKIMOTO HIROBUMI  
 KISO OSAMU

## (54) SOUND INSULATING DEVICE

### (57)Abstract:

PURPOSE: To make it possible to relax the sound generated by walking on a floor by connecting a plurality of vessels having an opening or a plurality of units which provide an opening chamber between the rear surface of a story floor and a ceiling on a board.

CONSTITUTION: A board 6 and a plurality of vessels 7, which are laid out in the form of a flat plate on the board 6, are installed on a sound insulating chamber 3 and opposed to each other on a floor board 1 which uses the opening 8 of each opening vessel 7 as a sound source. Then, each opening vessel 7 is arranged to act as a vibration insulating material 5. For example, it is laid out on the board 6 by way of felt or butyl rubber. In addition, a foam or butyl rubber or the like which acts similarly as a vibration insulating material is laid out between each vessel 7. In this case, these boards 6 and vessels 7 are modulated on an unit basis. Each unit is installed between beams 4. Furthermore, each unit is connected with a connecting material 10 and a wood screw 11. A sound absorbing material 12 is housed in each opening vessel 7 while a rear air layer 13 is installed between the bottom of the vessel and the sound absorbing material 12, which makes it possible to attenuate the sound which spreads in each vessel effectively.



### LEGAL STATUS

[Date of request for examination] 14.01.1998

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3072023

[Date of registration] 26.05.2000

[Number of appeal against examiner's decision]

[of rejection]

[Date of requesting appeal against examiner's  
decision of rejection]

[Date of extinction of right]

(19) 日本国特許庁 (JP)

## (12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平8-319680

(43) 公開日 平成8年(1996)12月3日

(51) Int.Cl.*	識別記号	庁内整理番号	F I	技術表示箇所
E 04 B 1/86			E 04 B 1/86	K
G 10 K 11/16			G 10 K 11/16	D

審査請求 未請求 請求項の数 6 OL (全 9 頁)

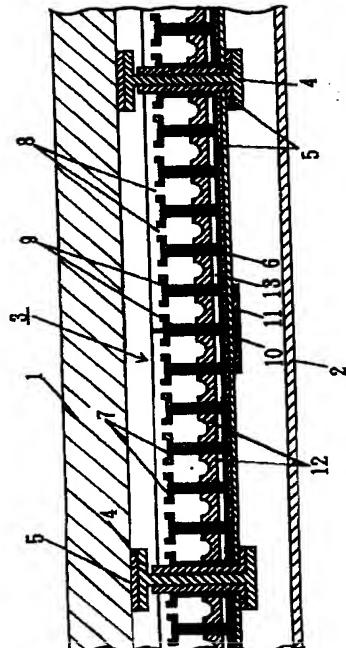
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		(72) 発明者	木曾 治 広島県福山市幕山台2丁目31番5号
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## (54) 【発明の名称】 遮音装置

## (57) 【要約】

【目的】 本発明は床衝撃音を改善するのに適した遮音装置に関するものであり、上階の床板と下階の天井との間のいわゆる天井裏空間に設置して、住空間に影響を与えることなく、床上での走り回り、歩行等により発生する音を緩和する装置に関するものである。

【構成】 階上床裏面と天井の空間に、基板上に開口部を有する容器を配置し、または基板と上板および仕切り板により複数の開口室を設けたユニットを複数個連結することにより設置する。



## 【特許請求の範囲】

【請求項1】 ユニット基板と、このユニット基板上に平面状に配置した多数の開口容器とを具え、各開口容器内に吸音材を配置して音源からの音波を各開口容器により減衰させるように構成したことを特徴とする遮音装置。

【請求項2】 請求項1記載の遮音装置において、前記ユニット基板と開口容器との間、または互いに隣接する開口容器間に、粘弾性部材を含む拘束型振動防止材を配置するように構成したことを特徴とする遮音装置。

【請求項3】 ユニット基板と、この基板上に配置され、多数の遮音室を画成する仕切り板と、仕切り板上に配置した上側プレートとを具え、各遮音室内にそれぞれ吸音材を配置したことを特徴とする遮音装置。

【請求項4】 請求項3記載の遮音装置において、前記上側プレートに、各遮音室毎にそれぞれ開口部を形成したことを特徴とする遮音装置。

【請求項5】 請求項1から請求項4までのいずれか一項に記載の遮音装置において、前記吸音材とユニット基板との間に背後空気層を形成し、吸音材による吸音効果を一層増強したことを特徴とする遮音装置。

【請求項6】 請求項3から請求項5までのいずれか1項に記載の遮音装置において、前記仕切り板に貫通孔を形成し、各遮音室に入射した音波が貫通孔を介して隣接する遮音室に伝播する過程で空気抵抗により音波が減衰するように構成したことを特徴とする遮音装置。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は建築物の遮音装置に関するものであり、上階の床と下階の天井との間のいわゆる天井裏空間に設置して、住空間に影響を与えることなく、床上での走り回り、歩行等により発生する音である重量床衝撃音および軽量床衝撃音を緩和するのに特に好適な装置に関するものである。しかしながら、本発明は、上階の床板が振動した結果発生する音や振動を伝播しにくくする、遮音、吸音、防振および制振の各手段を複合した装置を床板と天井との空間に設置するものであるため、基本的には床衝撃音に限らず、あらゆる音源に対して有効であって、広範囲の産業分野での利用が可能である。

## 【0002】

【従来の技術】 従来、床衝撃音の緩和に関し、重量音に對しては床板の剛性を上げたり、床板の重量を増加する等の対策が講じられており、一方軽量音に對しては、床仕上材を柔らかくする、二重床として床板への加振力を低減させる等が行われていた。その結果、コンクリート造の集合住宅では、床板厚および配筋が増加することとなり、床板の剛性と重量が増大するため柱や梁の強度を上げる必要が生じ、これに伴い建設コストも増加する。

【0003】 これに対し、スラブ内に空間を持たせて、

剛性を保ちながら軽量化するボイドスラブやワッフルスラブ等が用いられているが、床板厚が厚くなり、かつ建物全体の高さが高くなるため、床、柱、梁の重量が増加し、また1階あたりの供給戸数が減少することにより、建設コストの増加を招く。

【0004】 また、木造在来工法やプレハブ造等の戸建住宅や低層アパートでは、建物が柔構造であるために床衝撃音が改善されにくく、特に重量衝撃音では床板以外にも天井や壁も共振して大きな放射音が発生する問題があつた。

【0005】 一方、軽量衝撃音に對しては、二重床とし、またはカーペット仕上げ床等の床材を柔らかくする等により、音性能がL<sub>10</sub>-45等級以下の床材が開発され、市販されている。しかしながら、カーペットは掃除が不充分となり易くダニ等の害虫の温床となるため、衛生上の観点から木質防音床が多用されている。

【0006】 ところが、木質仕上材は踏み心地が固いものと一般に認識されているため、柔らかい踏み心地の木質床は、音性能は良いものの、居住者からは敬遠される。すなわち、木質床の音性能と踏み心地は相反し、これらを両立させることは困難であった。

【0007】 また一方で、床は常に交換するものではなく、長期間、半永久的に使用するものであるから、長期使用によって音性能が変化するものであつてはならない。しかし、床衝撃音を低減させるために使用した材料が繊維や発泡体等の場合は、長期荷重により圧縮永久歪を生じるため、床衝撃に対する緩和効果が低下し、床衝撃音の低減効果が低下する問題が生じることが知られている。

【0008】 上記のように、床衝撃音を低減するための研究は、重量音については床板自体の厚さの増加、剛性の増加および軽量化が行われているにすぎず、また、軽量音については床材の材質面での検討のみが行われているのが現状である。

## 【0009】

【発明の解決しようとする課題】 本発明の解決しようとする課題は、①床衝撃音を広い周波数帯域で減衰させること、②長期間供用しても性能低下しないこと、③住空間を狭くしないこと、の三条件を満足する遮音装置を提案することである。

## 【0010】

【0010】 本発明者等は前述した問題点を踏まえ、放射音の発生源である天井と床板の間の空間に、放射音を減衰させる装置を設置すれば上記の各条件を同時に満足することが可能であることを多くの実験により確認し、本発明を完成した。

## 【0011】

【課題を解決するための手段並びに作用】 本発明による遮音装置は、ユニット基板と、このユニット基板上に平面状に配置した多数の開口容器とを具え、各開口容器内に吸音材を配置して音源からの音波を各開口容器により

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減衰させるように構成したことを特徴とする。

【0012】本発明は、基本的にはヘルムホルツの共振子の原理を利用して遮音装置を達成するものである。このため、ユニット基板上に多数の開口容器を平面状に配置する。開口容器の内部空間は空洞部として作用するので、開口を経て入射した音波により容器内の空気が圧縮および膨張を繰り返し、音波のエネルギーを減衰させることができる。特に、開口容器の体積を適切に選択することにより、特定の周波数の音源に対して顕著な減衰効果を発揮するため、床衝撃音の周波数に適合するように開口容器の体積を設定する。これにより、優れた遮音効果が発揮されるものである。

【0013】さらに本発明では、開口容器内に吸音材を配置する。吸音材として、ロックウール、グラスウール、フェルト、不織布などの繊維材料、コルク、ゴム、発泡体などを用いることができる。このように、開口容器内に吸音材を配置することにより、開口容器の減衰効果に加えて吸音材による減衰効果が達成され、一層優れた遮音効果を達成できる。

【0014】本発明による遮音装置の好適実施例は、ユニット基板と開口容器との間、または互いに隣接する開口容器間の少なくとも一方に粘弾性部材を含む拘束型振動防止材を配置するように構成したことを特徴とするものである。開口容器とユニット基板との間、または隣接する開口容器間に振動絶縁材を配置することにより、音波が入射すると各開口容器が拘束振動を行い、開口容器自体の振動に対しても制振効果を与えることができる。この結果、遮音される音波の周波数帯域を一層拡大することができる。

【0015】本発明による別の遮音装置は、ユニット基板と、この基板上に配置され、多数の遮音室を画成する仕切り板と、仕切り板上に配置した上側プレートとを具え、各遮音室内にそれぞれ吸音材を配置したものである。ユニット基板、仕切り板および上側プレートにより画成した多数の遮音室は、前述したように入射した音波に対して空洞共振部として作用し、この結果、内部空気層が圧縮および膨張することにより音波のエネルギーを減衰させることができる。この場合、各遮音室毎にそれぞれ開口部を設けることにより、ヘルムホルツの共振子としての効果が一層有効になり、遮音効果が大する。

【0016】上記好適実施例において、遮音室内に背後空気層が形成されるように吸音材を配置すれば、各遮音室内に吸音材が分離した2個の遮音空間が形成されることにより、吸音材の吸音効果が一層有効に作用すると共に、入射した音波が2回減衰作用を受けるようになり、音波に対する減衰効果も格段に増強する。

【0017】さらに、本発明の好適実施例は、前記仕切り板に貫通孔を形成し、各遮音室に入射した音波が貫通孔を介して隣接する遮音室に伝播する過程で空気抵抗により音波が減衰するように構成したものである。このよ

うに仕切り板に貫通孔を設けることにより、各遮音室に入射した音波は、さらに貫通孔を経て隣接する遮音室まで伝播し、また音波間の相互干渉作用により音波に対する減衰効果が一層増大する。

【0018】本発明によれば、住空間を狭くすることなく、荷重その他の影響を受けないため長期供用による性能低下もなく、また遮音、吸音、防振および制振の各機能を複合したユニットを組み合わせるため、床板で発生した振動や放射音を緩和でき、さらに広い周波数帯域で有効であるため、重量衝撃音、軽量衝撃音の両方に対して効果が発揮できるものである。

【0019】本発明の遮音装置のユニット基板となる箱状ユニット基板および平面状ユニット基板は、合板、インシュレーションボード、センチュリーボード、木材等の木質材、ダンボール等の紙材、塩化ビニル、A B S、ポリエチレン、ポリプロピレン、アクリル等の合成樹脂、天然ゴム、E P T、B R、C R、I R、I I R等のゴム、エポキシ、不飽和ポリエステル、フェノール、ウレタン、液状ゴム、シリコン等の反応硬化型液状樹脂、石膏ボード、木毛セメント板、フレキシブルボード、中空セメント押出成型板等の無機質板、ガラス繊維、ロックウール、不織布、フェルト等の圧縮成型板状物、鉄、ステンレス、アルミニウム、鉛等の金属板を単独または併用して使用可能である。

【0020】また、箱状ユニット基板は、前記の材料からなる平面状基板を組み立たるものでも、プラスチック等の一体成型で作製したものでもよい。

【0021】箱状ユニット基板および平面状ユニット基板について特に考慮すべき点は、遮音性能上は面密度の高いものが望ましいこと、基板からの放射音を防ぐためリブ、補強材を設けてユニットとしての剛性を上げること、制振材との組み合わせにより拘束または非拘束型制振とすること、ユニットの固定位置を床板や天井と一体化しないこと、さらに床板、梁、天井と連結固定する場合には振動絶縁材を介して固定することにより、放射音の発生しない振動しにくい構造とすることは一層効果的である。

【0022】ユニット間およびユニット端部等の取合部では、隙間が生じないように板状物、箱状物間に振動絶縁材や接合板等を用いること、および接合部を相決り接合や本実接合とし、隙間からの音漏れを防止することが必要である。

【0023】開口容器は箱状ユニット基板、平面状ユニット基板と同様に材質や厚さには特に制約がないが、薄く剛性の高い材質である金属や高剛性プラスチックの場合は開口容器自体が振動して放射音を発生するおそれがある。しかし、開口容器の内周、外周あるいは上部の少なくとも一部にロックウール、グラスウール、フェルト、不織布等の繊維、コルク、ゴム、発泡体等の振動絶縁材、吸音材、ダンパー等を単独又は併用して設けるこ

とにより、放射音が発生しない構造とすることができます。このような構造は特に低周波振動に対して有効となる。また、この場合、箱状ユニット基板や平面状ユニット基板と接する開口容器底面との間に繊維質や発泡体、粘弹性体を介し、更に開口容器の器壁を粘弹性体を介して固定したときにも優れた効果が発揮される。すなわち、容器底部と箱状ユニット基板または容器底部と平面状ユニット基板との間では水平方向の拘束効果による制振が行われ、一方、容器の器壁間では垂直方向の拘束効果による制振が行われることにより、2軸方向の拘束型制振構造となり、非常に減衰しにくい低周波振動を制振する上で極めて有効である。

【0024】また、開口容器間に繊維系、発泡体系の吸音材を配置し、あるいは開口容器の上面に繊維系や連続気泡型の発泡体を設けることにより、高周波側の吸音効果をさらに向上させることができる。

【0025】開口容器内部および遮音室においては、これら空間内に層状の吸音材を入れるとともにその内部形状を凹凸面とすることにより、低周波数から中周波数領域の音の吸音効果を向上させ、更に吸音材と容器底の間を空間とし背後空気層を設けることにより、その効果は更に向上する。

【0026】また、開口容器底に石膏やセメント、バインダーで固めた砂等の比重の大きい物質を用いて、容器底に対して傾斜した面を形成することにより、音の反射が生じ、音波の行路長を、一定の空間でありながら、長くすることで減衰させるため、低周波音の低減効果を改善することができる。

【0027】平面状ユニット基板と上側プレートとの間に仕切り板を設けた遮音室を設置した場合には、仕切り板によりユニットの剛性を向上させることができ、ユニット自身が振動しにくい構造となる。

【0028】また、このユニットにおいて上側プレートに開口部を設け、その開口部に円錐体または角錐体を配置すると吸音効果が高くなる上、音の反射効果も併せて利用できる。この場合は上側板状物と円錐体、角錐体との間に形成される空間に石膏、セメントまたはバインダーを含む砂等を充填することにより、全周波数領域において音の低減効果が得られる。さらに、板状物や円錐体、角錐体と石膏、セメント等との間に粘弹性体を介して接着することにより、低周波音の低減効果を更に高めることができる。

【0029】開口容器は1個づつ独立したものでも、後述するように一体成形したものでも良い。形状については特に制約はないが、低周波振動を低減するためには、高さは高い方が良く、また開口部の面積も大きい方が良く、その厚みも厚い方が良い。しかし低周波から高周波にわたる広い範囲で効果を出すためには、前述の方法を併用して、また、建築物の構造によって多少の差が生じるため、これに対応した最適な形状および構造のユニットとすることが一層有効である。

【0030】一方、施工作業性に関しては、現場での切断性が重視されるため、木質、プラスチック、石膏等の切断しやすく、かつ、切断片で怪我をしにくい材料が望ましい。また、万一の火災時に備えて不燃性の石膏ボード、セメント板等を使用することにより二重天井の役目も果たし、類焼速度を遅らせる効果も生じる。

【0031】

【実施例】以下、本発明を実施例により具体的に詳述する。

【0032】図1は、本発明による、基板上に開口容器を設置した遮音装置3を設置した実施例を示す断面図である。遮音装置3により、床板1で発生した衝撃音が天井板2に伝播するのを防止する。遮音装置3は、梁4を介して床板1に連結する。梁4と遮音装置3との間、並びに梁4と床板1との間には振動絶縁材5を介在させる。

【0033】遮音装置3は、基板6と、この基板上に平面状に配置した複数の開口容器7とを有し、各開口容器の開口部8は、音源となる床板1に対向する。各開口容器は振動絶縁材5として作用する、例えばフェルトまたはブチルゴムを介して基板上に配置する。また、各容器間にも同様に振動絶縁材9として作用する発泡体、ブチルゴムなどを介在させる。これら基板と開口容器はユニット化され、各ユニットを梁間に設置する。各ユニットは、連結材10と木ねじ11で接合されている。さらに、各開口容器内に吸音材12を収納し、また容器底部と吸音材との間に背後空気層13を設けることにより、各容器内に伝播した音を効果的に減衰させることができる。

【0034】図2は、図1に示した基板と開口容器から構成される遮音装置のユニットの一例を示すものである。本ユニット14は、基板として2枚の板15および16を相決り接合し、接合部の音漏れを防止している。この基板上に、開口部17を有する開口容器18を複数設置している。

【0035】図3は、図1に示した遮音装置のユニットの他の例を示したものである。本ユニット19は、箱状基板20内に、開口部21を有する開口容器22を複数設置した構成とする。このように、箱状の基板を用いることにより、複数の容器を容易にユニット化することができる。

【0036】図4は、本発明による遮音装置の第1の実施例の変形例23について、その断面図を示すものである。2枚の板24および25を互いにすらして重ね合わせ、相決り接合部を設けて接合部の隙間からの音漏れを防止している。板25上に振動絶縁材26としてブチルゴムのシートを数設し、その上に開口部27を有する容器28を、開口部を上向きにして複数設置する。また各容器間の隙間にも振動絶縁材29を設けている。

【0037】図5は、本発明による遮音装置の第1の実施例の変形例30について、その断面図を示すものであ

る。箱状基板31は石膏ボードと合板を重ね合わせて作製し、その底部に振動絶縁材として厚さ10mmのフェルト32を敷設し、その上に開口容器33を開口部を上向きに配置している。容器間には、発泡硬化後に容器底から10cmの高さになるように液状発泡硬化材料34を充填し、発泡硬化させた。この発泡硬化材料は、硬化するまでの液状物の段階でフェルトに一部含浸し、容器間および容器底部とフェルト間を接着するため、拘束効果を発揮する。また容器33内部には、断面が凹状面を形成するようにフェルトからなる凹面状吸音材35を充填し、吸音効果を増加させている。

【0038】図6は、本発明による遮音装置の第1の実施例の変形例36について、その断面図を示すものである。図5と同様、箱状基板31内にフェルト38を敷設し、その上に開口容器39を配置し、容器間に発泡材料40を充填しているが、開口容器39底部にモルタル41を傾斜させて流し込み、硬化させ、その上に凹面状吸音材42を、モルタル41との間に背後空気層43を形成するように設置している。

【0039】図7は、本発明による遮音装置の第2の実施例として、上階の床板と下階の天井との間に、床板および天井とは独立した格子状受け木に固定したことを示す断面図である。遮音装置44は、床板45と天井46との間に、図示しない支持部材によって支持されている格子状受け木47および48上に設置されている。本装置では上部板49、下部板50および仕切り板51で複数の空間52を設けている。そして、これらの空間を形成することにより、床板で発生した衝撃音が下階の天井板に伝播するのを防止する。

【0040】図8は、本発明による遮音装置の第2の実施例の変形例53について、その断面図を示すものである。上下の石膏ボード54および55間に仕切り板56および57を設けている。仕切り板間の接合は本実接合とし、右側の仕切り板56には凸部を、左側の仕切り板57には凹部をそれぞれ設ける。さらに石膏ボード間には仕切り板58を格子状に設け、内部を細分割することにより区画を形成する。各区画内にはロックウールからなる吸音材59と、これを支える落下防止材60を設けている。吸音材59と落下防止材60および下側の石膏ボード55で仕切られた空間は背後空気層61として、吸音効果をより向上させる効果を有している。また、これと同時に、吸音材59と上側の石膏ボード54で仕切られた空間62も、背後空気層と同様の効果をもたらしている。

【0041】図9は、本発明による遮音装置の第2の実施例の変形例63について、その断面図を示すものである。図6に示す実施例と同様、上下の石膏ボード64および65間に、仕切り板66、67および68により区画を設け、各区画内には吸音材69と、これを支える落下防止材70および背後空気層71を設けている。仕切り板68には通気孔72を設け、各区画内に通気する構造となっている。

【0042】図10は、本発明による遮音装置の第2の実施例の変形例74について、その断面図を示すものである。図8および図9に示す実施例と同様、上下の石膏ボード75および76間に、仕切り板77、78および79により区画を設け、各区画内には吸音材80と、これを支える落下防止材81および背後空気層82を設けている。また、上側の石膏ボード75に開口部83を設け、この開口部上に、四角錐状のロート状部材84を、モルタルとの接着性を有する粘弹性体85を介して、モルタル86により石膏ボード75と接着している。このロート状部材84により、音波の入射角と反射角との関係から生じる音波の反射を利用して、天井側への音波の伝播量を減少させている。

【0043】図11は、本発明による遮音装置の第2の実施例の変形例88について、その断面図を示すものである。基板89上に粘弹性体90を貼り付け、その上に連続して一体成形した開口容器91を設置し、さらに容器上に吸音材92を設け、容器内に空間93を設けている。

【0044】図12は、本発明の各実施例に係る供試体に對して床衝撃音の測定を行った試験室の2階床の平面図20を示すものである。床板94の中央部に大きさ1.8m×1.8mの開口部95を設け、その中にALC床板96を3枚取り付けている。また、対角線上に打点97を5点設けている。

【0045】図13は、本発明の各実施例に對して床衝撃音の測定を行った試験室の1階の平面図を示すものである。床板98上の対角線の交点および1/4の点の計5か所の測定点99で受音して測定を行った。測定に際しては、実施例に係る供試体を2階床と1階床との間に、両者とは独立に設置して行う。

【0046】図14は、測定装置の概略図を示すものである。精密騒音計101に接続されたマイクロホン100で受信した音を周波数分析器102で解析を行い、記録計103で結果を記録する。

【0047】以下、本発明の各実施例およびこれを用いた測定結果について詳述する。

#### 【0048】1. 供試体の作製

ユニットA：断面図を図4に示すように、厚さ9mm×幅45cm×長さ90cmの2枚の石膏ボード24および25を幅および長さ方向に各々10cmずらせて相接り接合部を設けて重ね合わせた板状物上に、幅15cm×長さ15cm×高さ20cm40で、直徑9cmの円形の開口部27を有するポリエチレン製容器28を、板状物と容器の底および容器の器壁間を厚さ1mmのブチルゴム粘弹性体26および29でそれぞれ固定してユニットAを作製した。

【0049】ユニットB：断面図を図5に示すように、ユニットAに用いた開口容器と同型の容器の上部5cmを切断して開口部を15cm×15cmとした開口容器33を作製し、その内部に凹状面を形成するようにフェルト35を充填する。この容器を厚さ12mmの合板と厚さ9mmの石膏ボードを貼合わせた箱状基板31の底部に厚さ10mmのフェル

ト32を敷き入れた後に設置した後、容器間に容器の10cm高さまで液状発泡効果材料34を充填して発泡硬化させたユニットBを作製した。

【0050】ユニットC：断面図を図6に示すように、ユニットBに用いた開口容器と同形状の開口容器39を作製し、その容器の底部にセメントモルタル41を流し込み底面と約30°の角度となる面を設け、さらに背後空気層43の高さを30mmとして凹面状吸音材42を充填した容器を、ユニットBと同様に箱状基板37の底部にフェルト38、容器間に発泡体40を形成したユニットCを作製した。

【0051】ユニットD：断面図を図8に示すように、厚さ9mm×幅45cm×長さ90cmの2枚の石膏ボード54および55間に周囲を幅5cm×高さ10cmの仕切り板56および57で仕切り、内部を幅1cm×高さ10cmの仕切板58を15cmピッチで縦横に格子状に設けて、格子内部に厚さ2cmのロックウール59および厚さ5cmの背後空気層61を設けたユニットDを作製した。

【0052】ユニットE：断面図を図9に示すように、ユニットDと同様の構成のユニットの隣合う仕切り部に対し、仕切り板68に直径10mmの通気孔72を設けたユニットEを作製した。

【0053】ユニットF：断面図を図10に示すように、ユニットDと同様の構成のユニットにおいて、上側板75に開口部83を設け、四角錐状のロート84をセメントモルタル86を介して取付けた。尚、板とロートのセメントモルタルと接する部分は生モルタルとの接着性を有する再\*

\*生ゴム系粘弹性体85をあらかじめ設けておいた。これをユニットFとした。

【0054】ユニットG：断面図を図11に示すように、厚さ12mm×幅45cm×長さ90cmの合板89に連続的に一体加工して作った塩化ビニール製の開口容器91を粘弹性体90を用いて貼付け、開口容器91の上にロックウール92を設けたユニットGを作製した。

#### 【0055】2. 供試体の設置

ユニットA～ユニットGを、それぞれ床板および天井と独立して隙間なく取付けた。

#### 【0056】3. 試験方法

##### 床衝撃音の測定

図12に示すように、2階の床板94に大きさ1.8m×1.8mの開口部95を設け、厚さ100mm、大きさ0.6m×1.8mのALC床板96を3枚並べ、その上からセメントモルタルを10mm増打ちし、乾燥後供試した。測定は、床板上に打点97を5カ所設け、各打点に対して衝撃を与え、発生した音を図13に示すように下階の床板98上の高さ1.2mの高さの所に5カ所設けた受音点99で測定し、結果を各受音点での測定値の平均値で示した。試験項目は重量衝撃音、軽量衝撃音の2通りとした。

【0057】床衝撃音の測定結果を表に示す。なお、本表における比較例とは、床板と天井との間には遮音装置を設置しない場合を示す。

#### 【0058】

##### 【表1】

		ユニット							比較例
		A	B	C	D	E	F	G	
重量衝撃音	63Hz	89dB	85dB	82dB	89dB	88dB	82dB	90dB	94dB
	125	80	74	72	78	77	71	82	90
	250	71	67	64	70	68	64	75	82
	500	66	59	55	62	60	57	69	78
	1000	59	49	48	53	52	48	60	68
	2000	44	40	38	41	40	39	53	61
	4000	34	32	31	38	35	33	42	57
	L <sub>w</sub> 等級	L <sub>w</sub> 65	L <sub>w</sub> 60	L <sub>w</sub> 60	L <sub>w</sub> 65	L <sub>w</sub> 65	L <sub>w</sub> 60	L <sub>w</sub> 70	L <sub>w</sub> 80
軽量衝撃音	63Hz	70dB	70dB	68dB	72dB	70dB	67dB	73dB	76dB
	125	71	72	69	75	73	68	76	80
	250	74	70	67	72	68	67	77	85
	500	64	64	62	63	62	61	72	79
	1000	49	50	48	49	50	49	54	64
	2000	33	34	32	31	31	33	38	51
	4000	20	20	18	18	18	19	23	36
	L <sub>U</sub> 等級	L <sub>U</sub> 70	L <sub>U</sub> 65	L <sub>U</sub> 60	L <sub>U</sub> 65	L <sub>U</sub> 60	L <sub>U</sub> 60	L <sub>U</sub> 70	L <sub>U</sub> 80

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【0059】試験結果に基づき、本発明の効果を説明する。

【0060】ユニットAは2枚の石膏ボードを重ね合わせた上に、開口容器を配置し、その際板状物と容器の底の間、および容器の器壁間を粘弹性物質によって連結固定した場合を示す。無処理の比較例と比べ重量音は3ランク、軽量音は2ランクの改善があり全周波数域で改善が見られた。

【0061】ユニットBは合板と石膏ボードを重ねた箱状の中に開口容器をセットし、箱状物と容器底の間をフェルト、容器間を発泡体でそれぞれ固定し、容器内に凹面状に吸音材を設けた例である。広い周波数に対して有効であった。

【0062】ユニットCは、供試体5の容器内部の底にセメントモルタルで約30°の角度となる面と背後空気層を設けた例である。この場合も特に低周波音の改善効果が生じ、重量音、軽量音共に4ランクの改善ができた。

【0063】ユニットDは2枚の石膏ボード間に仕切り板で空間を設け、その空間に吸音材を設けた例である。重量音、軽量音共に3ランクの改善が見られた。

【0064】ユニットEは仕切り板に連通穴を設けた例であり、ユニットDと比べて低周波音において改良の効果が見られる。

【0065】ユニットFは上側板材に開口部を設け、開口部に角錐型のロート状部材を設置し、更に板材とロート状部材との間に粘弹性体を介してセメントモルタルを設けた例である。試験結果より明らかに、特に低減しにくい低周波音が大きく改善されており、性能も5ランクの改善効果がみられた。

【0066】ユニットGは合板に一体成型した開口容器を粘弹性体で固定し、上に吸音材を設けた例である。この場合も重量音、軽量音とも2ランク改善しており、床衝撃音低減に有効であった。

#### 【0067】

【発明の効果】以上のように、従来利用されていなかった床板と天井の空間を有効利用することにより床衝撃音を緩和することができ、特にユニットCおよびユニットFは低周波領域での低減効果が大であり、その他の実施例でも広い周波数領域で有効であった。

【0068】なお、本発明の供試体に用いた各ユニットは、床板および床材は従来の製品を使用して行ったものであるため、これらの改良と併用することにより、歩行感に優れ、かつ重量増を抑えながら床衝撃音を低減することが可能である。

【0069】以上より本発明は、快適な住空間を提供する上で非常に有用であるのみならず、あらゆる音源に対して効果が発揮できることから、広範囲の産業分野での利用が可能である。

#### 【図面の簡単な説明】

【図1】本発明の遮音装置を床板と天井の間を利用して

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梁に固定したことと示す断面図である。

【図2】本発明の遮音装置を床板と天井の間を利用して、床および天井と独立した格子状受け木に固定したことと示す断面図である。

【図3】本発明の遮音装置が板状物と開口容器からなるユニットにより構成されている場合の斜視図である。

【図4】本発明の遮音装置が箱状物と開口容器からなるユニットにより構成されている場合の斜視図である。

【図5】本発明の遮音装置の供試体であるユニットAの断面図である。

【図6】本発明の遮音装置の供試体であるユニットBの断面図である。

【図7】本発明の遮音装置の供試体であるユニットCの断面図である。

【図8】本発明の遮音装置の供試体であるユニットDの断面図である。

【図9】本発明の遮音装置の供試体であるユニットEの断面図である。

【図10】本発明の遮音装置の供試体であるユニットFの断面図である。

【図11】本発明の遮音装置の供試体であるユニットGの断面図である。

【図12】本発明の供試体の測定における打点を示す概略図である。

【図13】本発明の供試体の測定における受音点を示す概略図である。

【図14】本発明の供試体に対する床衝撃音の測定に用いた測定装置の概略図である。

#### 【符号の説明】

- 30 1, 45 床板
- 2, 46 天井板
- 4 築
- 5, 9, 26, 29, 32, 34, 38, 40 振動絶縁材
- 6 基板
- 7, 18, 22, 28, 33, 39 開口容器
- 8, 17, 21, 27 開口部
- 10 ユニット間連結材
- 11 木ネジ
- 12, 35, 42 凹面状吸音材
- 40 13, 43, 61, 71, 82 背後空気層
- 15, 16, 24, 25, 89 板状ユニット基板
- 20, 31, 37 箱状ユニット基板
- 41, 86 モルタル
- 47, 48 格子状受け木
- 49 上板
- 50 下板
- 51, 56, 57, 58, 66, 67, 68, 77, 78, 79 仕切り板
- 54, 55, 64, 65, 75, 76 石膏ボード
- 52, 62, 73, 87, 93 空間
- 50 59, 69, 80 吸音材

60, 70, 81 落下防止材

72 通気孔

83 開口部

84 ロート状部材

85, 90 粘弾性体

91 一体成形型開口容器

92 吸音材

94, 98 床

\* 95 開口部

96 ALC床板

97 打点

99 受音点

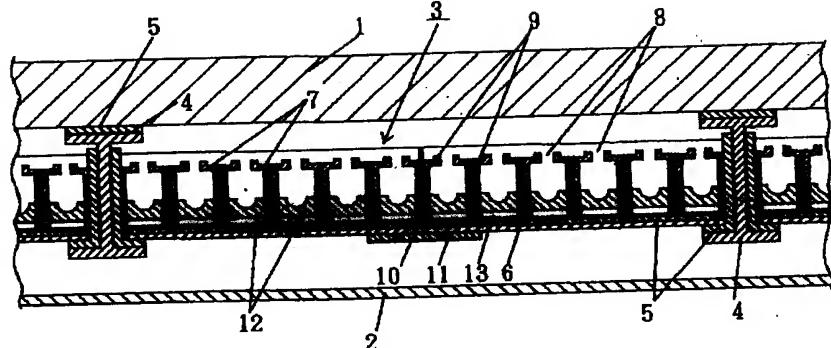
100 マイクロホン

101 精密騒音計

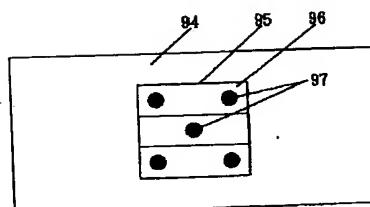
102 周波数分析器

\* 103 記録計

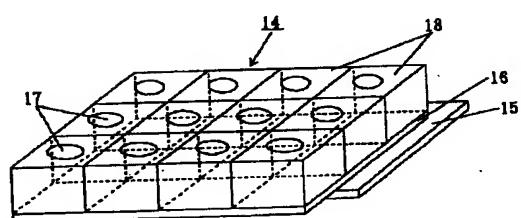
【図1】



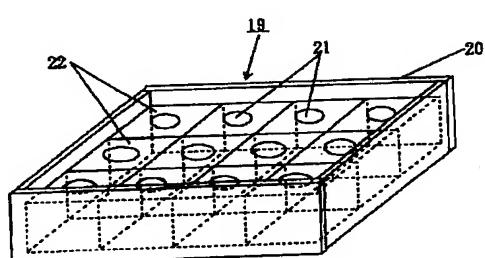
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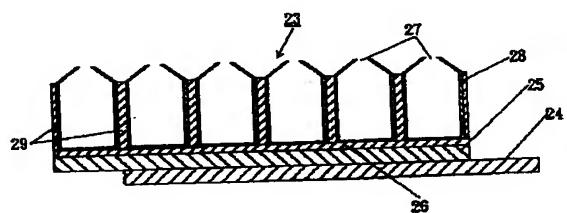
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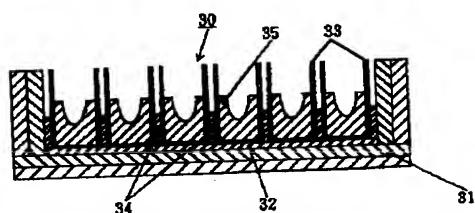
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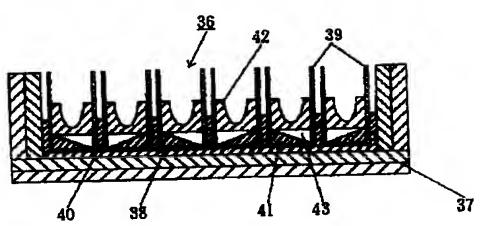
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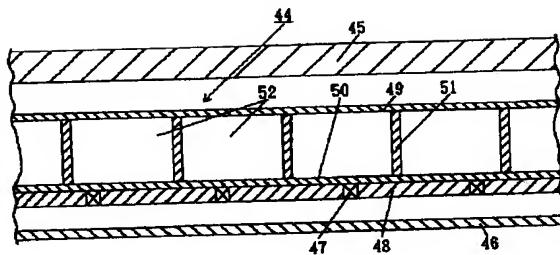
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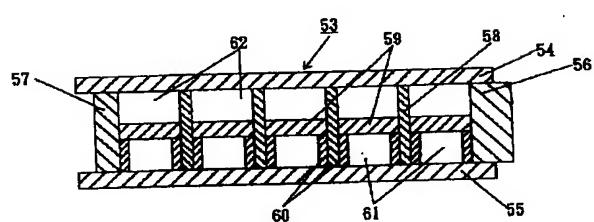
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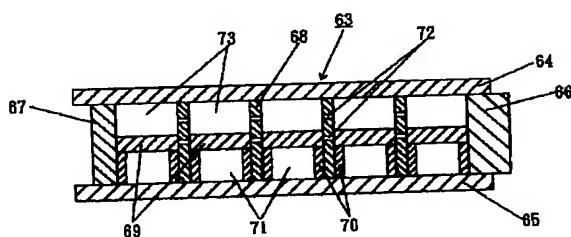
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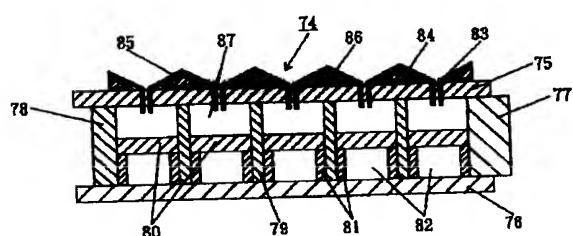
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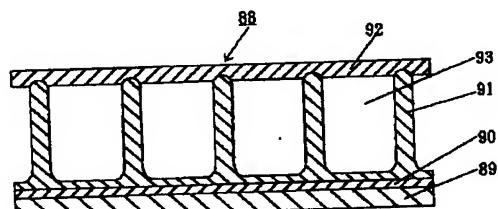
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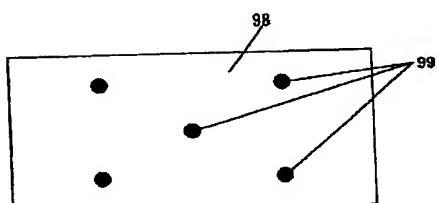
【図10】



【図11】



【図13】



【図14】

